

GSM-R developments as enablers towards FRMCS

Presented by Ingo Wendler

UIC representative at 3GPP

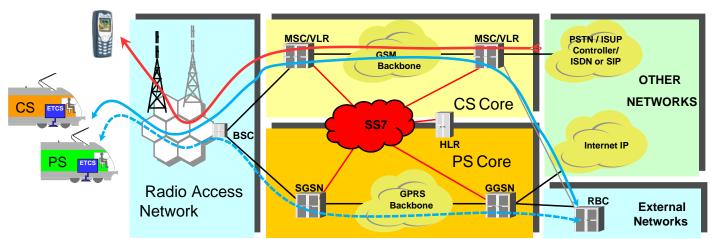


GSM-R - Today



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(CS) Circuit Switched Domain



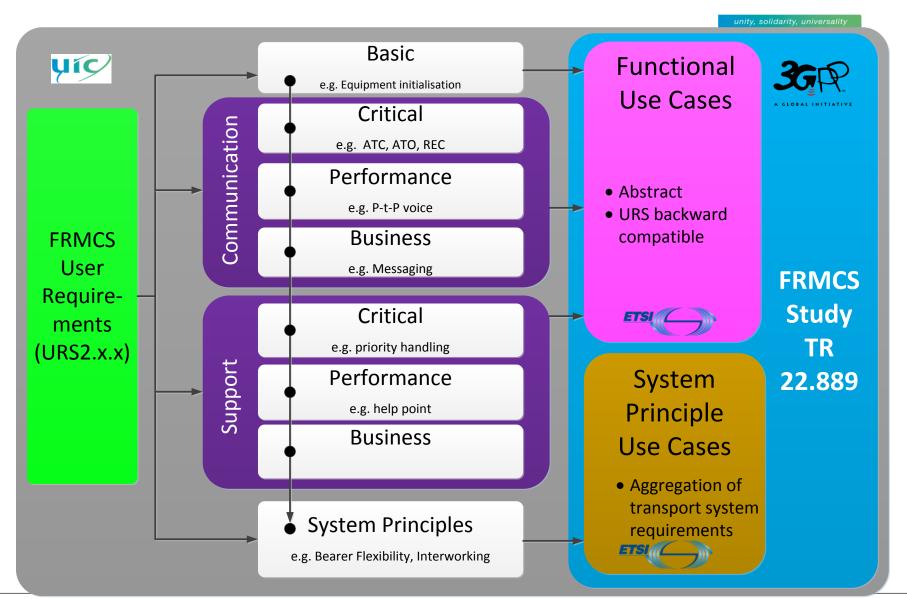
Review

(PS) Packet Switched Domain

- 3GPP narrowband communication system for voice, data and messaging
- Single Carrier approach paired with a specific frequency reuse
- Spectral efficiency rather low compared to the evolved 3GPP radio access systems
- Limited frequency resources in the UIC and E-UIC frequency band
- Connection oriented communication (Circuit Switched) consumes resources having a low duty cycle
- ETCS can be operated in Packet Switched mode using E(GPRS) bearer
- End-to-End functions are part of the Access and Core network
- System limitations may not cover all communication requirements today and in the future!

FRMCS Service development





3GPP Organizational Structure

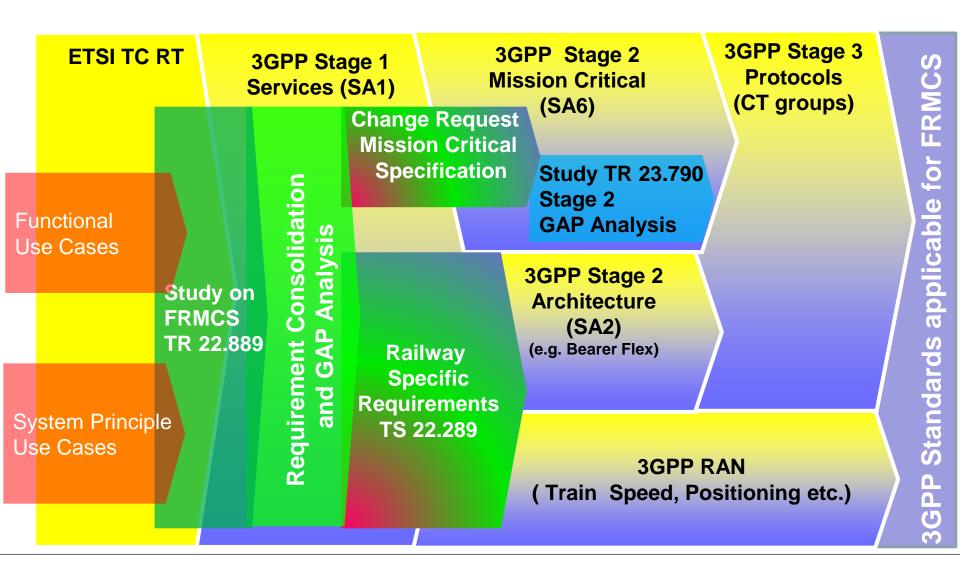


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3GPP TSG ORGANIZATION Project Co-ordination Group (PCG) **TSG SA TSG RAN TSG CT** Services & System Aspects Radio Access Networks (WCDMA & LTE) **Core Network & Terminals RAN WG4** CT WG1 **RAN WG1** SA WG1 SA WG4 Radio Performance MM/CC/SM (lu) Layer 1 **Services** Codec Protocol aspects CT WG3 **RAN WG2 RAN WG5** SA WG2 SA WG5 **Architecture** Layer 2 and Layer 3 Protocols Mobile Terminal **Telecom Management** nterworking with External Networks Conformance Testing **RAN WG3** CT WG4 **RAN WG6** SA WG3 SA WG6 lub spec, lur spec, lu spec MAP/GTP/BCH/SS Legacy RAN Security Mission-critical Applications **UTRAN O&M requirements** radio and protocol * TSG-GERAN was closed in mid-2016 CT WG6 and its tasks moved to RAN WG6. **Smart Card Application Aspects**

FRMCS at 3GPP





Services



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Multi-Media

CS - Circuit Switched Bearer Services

FRMCS

PS - Packet Switched Bearer Services

Voice Communication Point-to-Point & Point-to-Multipoint e.g. Voice Group Communication

Data Communication

Automatic Train Control (e.g. ETCS), Online Key Management etc.

Messaging (SMS, USSD)

GSM-R TECHNOLOGY

Video Communication (e.g. for ATO GoA 3 & 4)

Presence

Location Information

Direct Mode On-Network/Off-Network + Relay

FRMCS Key Principles (1) Bearer Agnostic approach

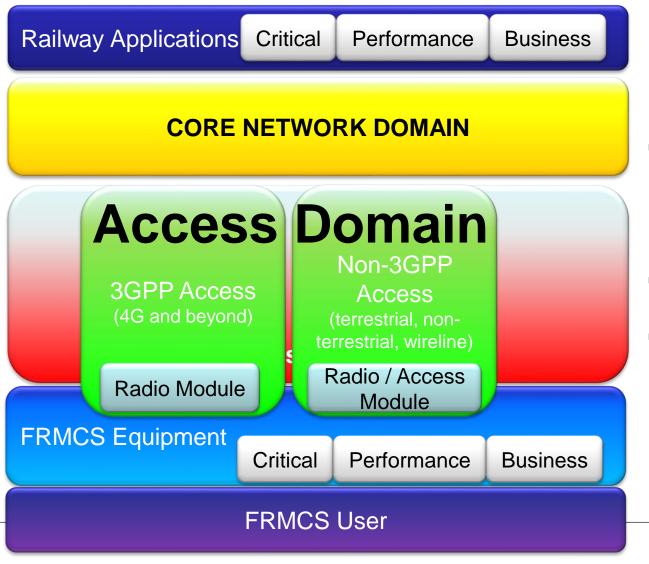


FRMCS Equipment Critical, Performance, Business Communication Applications | Arbitration Critical, Performance, Business Support Applications QoS Management **Basic Functionality** Bearer Service FRMCS Transport (Wireless, Wireline) QoS Management **FRMCS Service Engine** QoS Management Critical, Performance, Business Communication Applications

FRMCS Key Principles (2) Bearer Flexibility



- Ability to follow the 3GPP radio access technology evolution without replacing the entire communication system
- Allows convergence on functional level among stationary and nonstationary FRMCS Users
- Requires "AccessType" management
- Bearer Service
 independent
 signalling between the
 FRMCS Equipment and
 the Core Network
 Domain necessary



FRMCS Key Principles (3)



Access Domain

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3GPP Access Systems

- Increasing Spectral efficiency Use of (Super 3D) MIMO Technology
- Improve robustness against Doppler and Multipath Propagation High Train Speed capabilities
- Carrier aggregation to increase the transport bandwidth
- Low Latency, very high reliable data communication essential for automation
- Potential Radio Access Type candidates:
 - LTE / LTE Advanced
 - New Radio (NR 5G) Access will bring further decentralisation of the resources, exploration of the spectrum above 6GHz, Hybrid Multiple Access schemes → balance between random and scheduled access

Non-3GPP Access Systems

- Complementary to the 3GPP access
- Terrestrial (e.g. WiFi), non-terrestrial (e.g. Satellite) and wireline

"The Tactile Internet": Communications at the speed of human senses



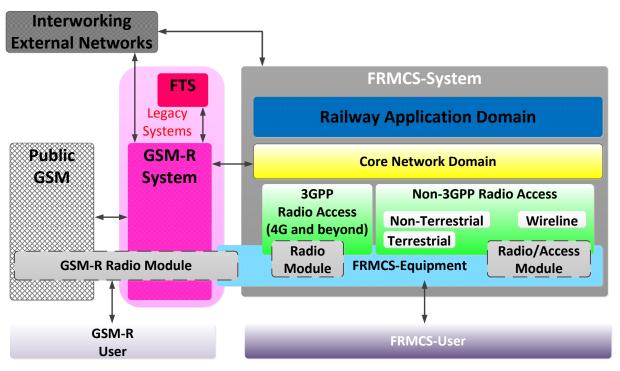






FRMCS Key Principles (4) Interworking



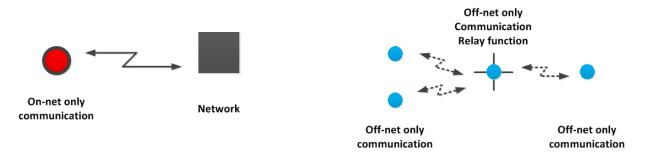


FTS - Fixed Terminal System

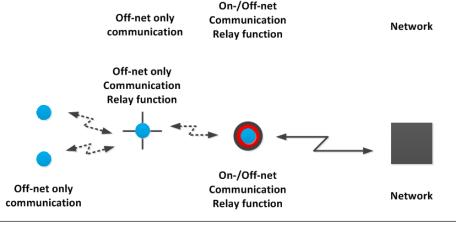
- Changes to GSM-R
 3GPP specification are not planned
- Interconnection for Circuit Switched Bearer Services except data and packet switched bearer services are in focus
- Functional interworking comprises Point-to-Point and Point-to- Multipoint communication
- FRMCS Equipment should provide GSM-R Radio Module Management facilities
- For FRMCS User only purposes, GSM-R can act as transport system!

FRMCS Key Principles (5) ON- and OFF-network





- FRMCS envisages the support of On-network and Off-network communication mode and the combination of both modes
- Use Cases:
 - Local Communication e.g. shunting(Off-network) including the controller (On-network)
 - ATC Virtual Coupling
 - Backup if On-network communication is unavailable
- Requires and initial Onnetwork mode contact for Authorisation of communication and application





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Thank You!